Kelly KDHA High Voltage Series/PM Motor Controller User's Manual

KDH07600A
KDH07601A
KDH07800A
KDH07801A
KDH09400A
KDH09401A
KDH09500A
KDH09501A
KDH12400A
KDH12401A
KDH12500A
KDH12501A
KDH14200A
KDH14201A
KDH14400A
KDH14401A

Rev.3.1
Dec /2008

Contents

Chapter 1 Introduction..... 2

1.1 Overview..... 2

Chapter 2 Main Features and Specifications.....3

2.1 General functions.....3

2.2 Features.....3

2.3 Specifications.....4

Chapter 3 Wiring and Installation.....5

3.1 Mounting the Controller..... 5

3.2 Connections.....7

3.3 Installation Checkout..... 13

Chapter 4 Maintenance.....14

4.1 Cleaning.....14

4.2 Configuration.....14

Table 1: LED CODES.....15

Contact Us:..... 17

Chapter 1 Introduction

1.1 Overview

The manual introduces Kelly HIGH VOLTAGE motor controller features, installation and maintenance. Read the manual carefully and thoroughly before use the controller. Should you have any questions, please contact the support center of Kelly Controls, LLC.

Kelly's programmable motor controllers provide efficient, smooth and quite controls for electrical vehicles like golf cart, go-cart, electric motorcycle, fork lift, hybrid vehicle, as well as electric boat and industry motor speed control. It uses high power MOSFET, fast PWM to achieve efficiency 99% in most cases. Powerful microprocessor brings in comprehensive and precise control to the controllers. It also allows users to set parameters, conduct tests, and obtain diagnostic information quickly and easily.

Chapter 2 Main Features and Specifications

2.1 General functions

(1) Extended fault detection and protection. LED flashing for fault code.
(2) Monitoring battery voltage. It will stop driving if battery voltage is too high. It will cut back then stop driving if voltage is going too low.
(3) Built-in current loop and over current protection.
(4) Controller temperature measurement and protection
(5) Current cutback at low temperature and high temperature to protect battery and controller. The current will ramp down quickly if controller temperature is higher than 90C, and shutdown at 100C. Low temperature current ramping down usually starts at 0C.
(6) The controller keeps monitoring voltage during regen. It will cut back current then cut off regen if voltage is going too high.
(7) Configurable to limit max reverse speed to half of max forward speed.
(8) Configurable and programmable with RS-232. Software upgradeable. Windows GUI provided.
(9) Provide 5V sensor supply
(10) 3 switch inputs. Close to ground to activate. Default to throttle switch, brake switch and reverse switch.
(11) 3 analog inputs, 0-5V. Default to throttle input, brake input and motor temperature input
(12) Reverse alarm output. Recirculation diodes provided.
(13) Main contactor driver. Cut off the power if any fault detected.
(14) Configurable max reverse power to half.
(15)Motor over temperature detection and protection, with recommended thermistor.
(16) Optional CAN bus.
(17) Optional supply voltage 8V-30V.

Caution! Regeneration has braking effect, but can't replace mechanical brake. Mechanical brake is required to stop your vehicle. Regen isn't a safety feature! Controller may stop regen to protect itself (not you!).

2.2 Features

•Intelligence with powerful microprocessor.
•Synchronos rectification, ultra low drop, fast PWM to achieve very high efficiency.
•Current limit and torque control.
•Low EMC.
•LED fault code helps user debugging.
•Battery protection: current cut back, shutdown and warning at low battery.
•Thermal enhanced rugged aluminum housing. Rugged connectors.
•Thermal protection: Current cut back on low temperature and high temperature to protect battery and controller.
•High pedal protection: Disable operation if power up with non-zero throttle.

•Brake switch is used to start regen.
•0-5V brake signal is used to command regen current.

2.3 Specifications

•Frequency of Operation: 16.6kHz.
•Standby Battery Current: <3 mA.
•Supply Voltage, PWR, 8 to 30V.
•Supply Current, 200mA @ 12V, or 2.5W
•Operating Voltage, B+, 18V to 136V
•Analog Brake and Throttle Input: 0-5 Volts. . Can use 3-wire pot to produce 0-5V signal.
•Reverse Alarm, Main Contactor Coil Driver, Meter: <1.5A.
•Full Power Temperature Range: 0C to 40C (controller case temperature).
•Operating Temperature Range: -30C to 90C, 100C shutdown (controller case temperature).
•Motor Current Limit,10 seconds boost: 200A,400A,500A,600A,800A, depending on model.
•Motor Current Limit, 1 minutes: 300A,350A,400A,600A,800A, depending on model.
•Motor Current Limit, continuous:100A,160A,200A,240A,320A, depending on model.

Kelly High Voltage DC Motor Controller						
Model	10 seconds boost current	1 minutes current	continuous current	Nominal Voltage Range	Max operating voltage	Regen
KDH07600A	600A	600A	240A	24V-72V	18V-90V	
KDH07601A	600A	600A	240A	24V-72V	18V-90V	*
KDH07800A	800A	800A	320A	24V-72V	18V-90V	
KDH07801A	800A	800A	320A	24V-72V	18V-90V	*
KDH09400A	400A	300A	160A	24V-96V	18V-120V	
KDH09401A	400A	300A	160A	24V-96V	18V-120V	*
KDH09500A	500A	400A	200A	24V-96V	18V-120V	
KDH09501A	500A	400A	200A	24V-96V	18V-120V	*
KDH12400A	400A	300 A	160A	24V-120V	18V-136V	
KDH12401A	400A	300 A	160A	24V-120V	18V-136V	*
KDH12500A	500A	400 A	200A	24V-120V	18V-136V	
KDH12501A	500A	400 A	200A	24V-120V	18V-136V	*
KDH14200A	200A	150 A	100A	24V-144V	18V-168V	
KDH14201A	200A	150 A	100A	24V-144V	18V-180V	*
KDH14400A	400A	350 A	160A	24V-144V	18V-168V	
KDH14401A	400A	350 A	160A	24V-144V	18V-180V	*
For supply voltage, all KDHA controllers are 8V-30V.						

Chapter 3 Wiring and Installation

3.1 Mounting the Controller

The controller can be oriented in any position as clean and dry as possible, or shield with a cover to protect it from water and contaminants.

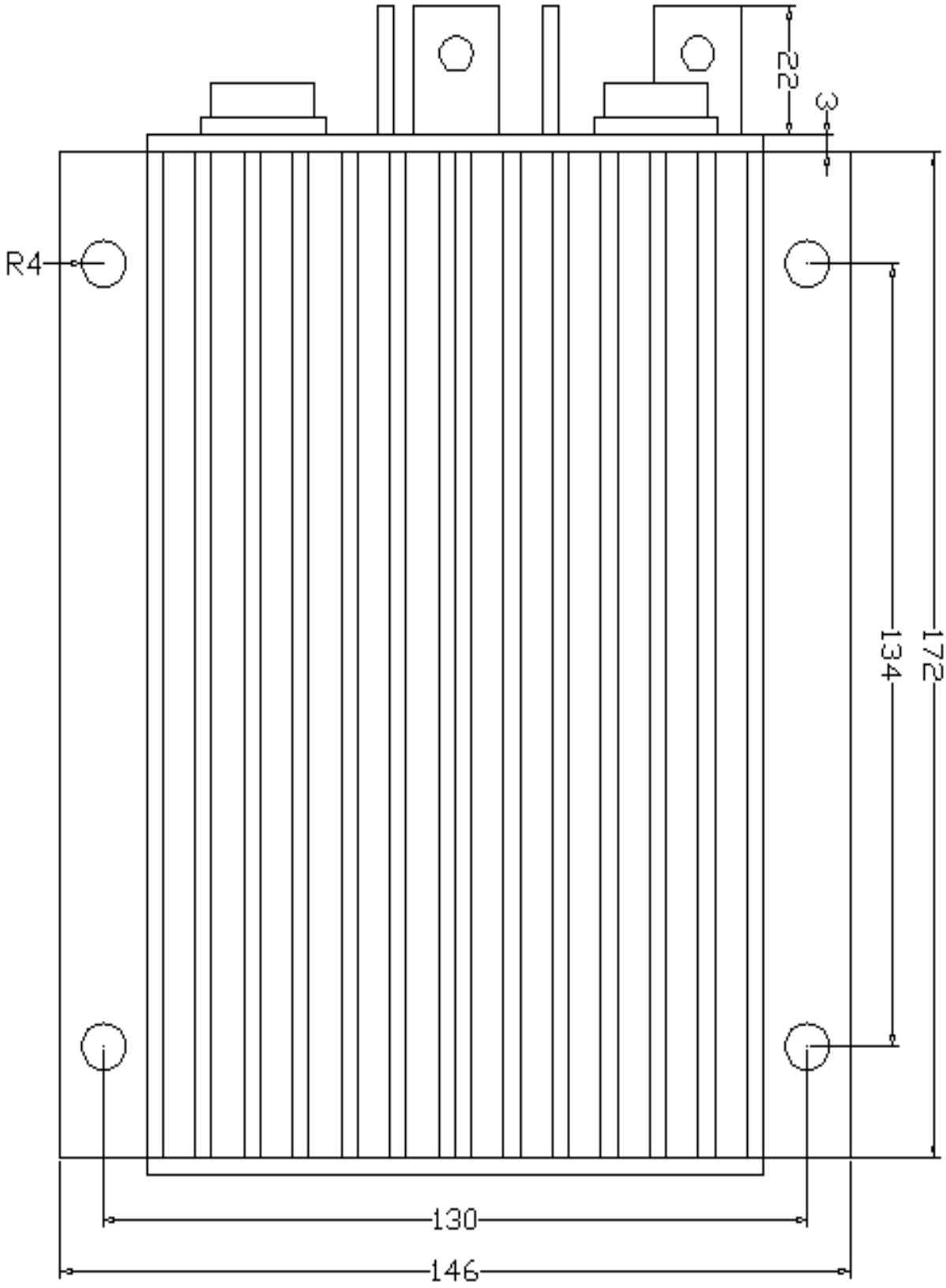
To ensure full rated output power, the controller should be fastened to a clean, flat metal surface with four screws. Applying silicon gel or other thermal conductive material to contact surface will enhance thermal performance.

Sufficient heat sink and air flow is required for high power application.

The case outline and mounting hole dimensions are shown in Figure 1.

Caution:

- **RUNAWAYS** — Some conditions could cause the vehicle to run out of control. Disconnect the motor, or jack up the vehicle, and get the drive wheels off the ground before attempting any work on the motor control circuitry.
- **HIGH CURRENT ARCS** — Electric vehicle batteries can supply very high power, and arcs can occur if they are short circuit. Always turn off the battery circuit before working on the motor control circuit. Wear safety glasses, and use properly insulated tools to prevent short.



Tall: 62 millimeters

Figure 1: mounting hole dimensions (dimensions in millimeters)

3.2 Connections

3.2.1 Front Panel of KDH Motor Controller:

Five metal bars and two plugs (J1, J2) are provided for connections to the battery, motor and control signals in the front of the controller shown as Figure 2.

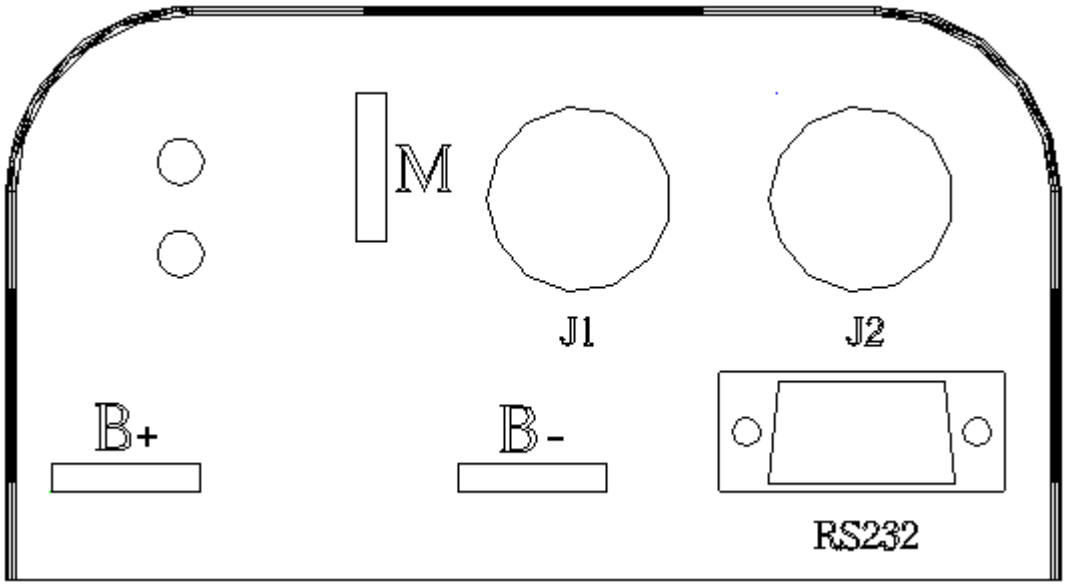


Figure 2: Front panel of KDHA motor controller picture

B+: Battery positive
B-: Battery negative
M: Armature Output

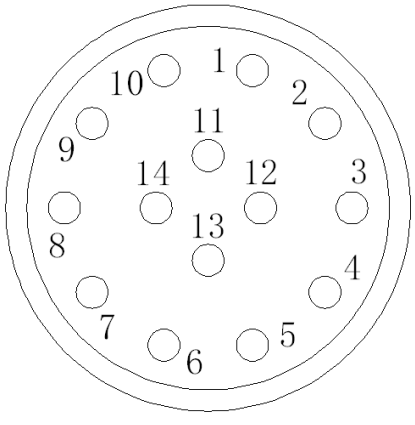


Figure 3: The connecting diagram of **J1** and **J2**

J1 Pin Definition

1- **PWR: Controller power supply (output). The pin is Red LED for S/N less :08XXXXXX.**
2- **Current meter. <200mA**
3- **Main contactor driver. <1.5A**
4- **Alarm: To drive reverse beeper,<200mA.**
5- **GND: Signal return**
6- **Green LED: Running indication**
7- **GND: Signal return**
8- **RS232 receiver**
9- **RS232 transmitter**
10- **CAN bus high. Optional**

11- CAN bus low. Optional
12- Reserved
13- GND: Signal return, or power supply ground
14- Red LED: Fault code.The pin is PWR for S/N less :08XXXXXX.

J2 Pin Definition

1- PWR: Controller power supply (input)
2- GND: Signal return, or power supply ground
3- GND: Signal return
4- Motor temperature input.
5- Throttle analog input, 0-5V
6- Brake analog input, 0-5V
7- 5V: 5V supply output. <40mA
8- Throttle switch input
9- Reverse switch input
10- Brake switch input
11- Reserved
12- Reserved
13- Reserved
14- GND: Signal return

Notes:

1. All GND pins are internally connected.
2. Two PWR pins, J1-14 and J2-1, are internally connected. It's recommended to use J1-14 to supply peripherals like alarm and meters. Twist peripheral wires with PWR is the preferred for EMC. Recirculation diodes are provided in the controller to PWR for alarm and meter drivers.
3. Switch to ground is active. Open switch is inactive

Caution: Make sure all connections are correct before apply power. Otherwise it may damage the controller! Please securely wire B- before applying power. It's preferred to place contactor or breaker on B+. Don't connect GND to B-.Please place precharge resistor on any breaker! It can cause damage without it!!!

3.2.2 Standard Wiring of KDHA Motor Controller

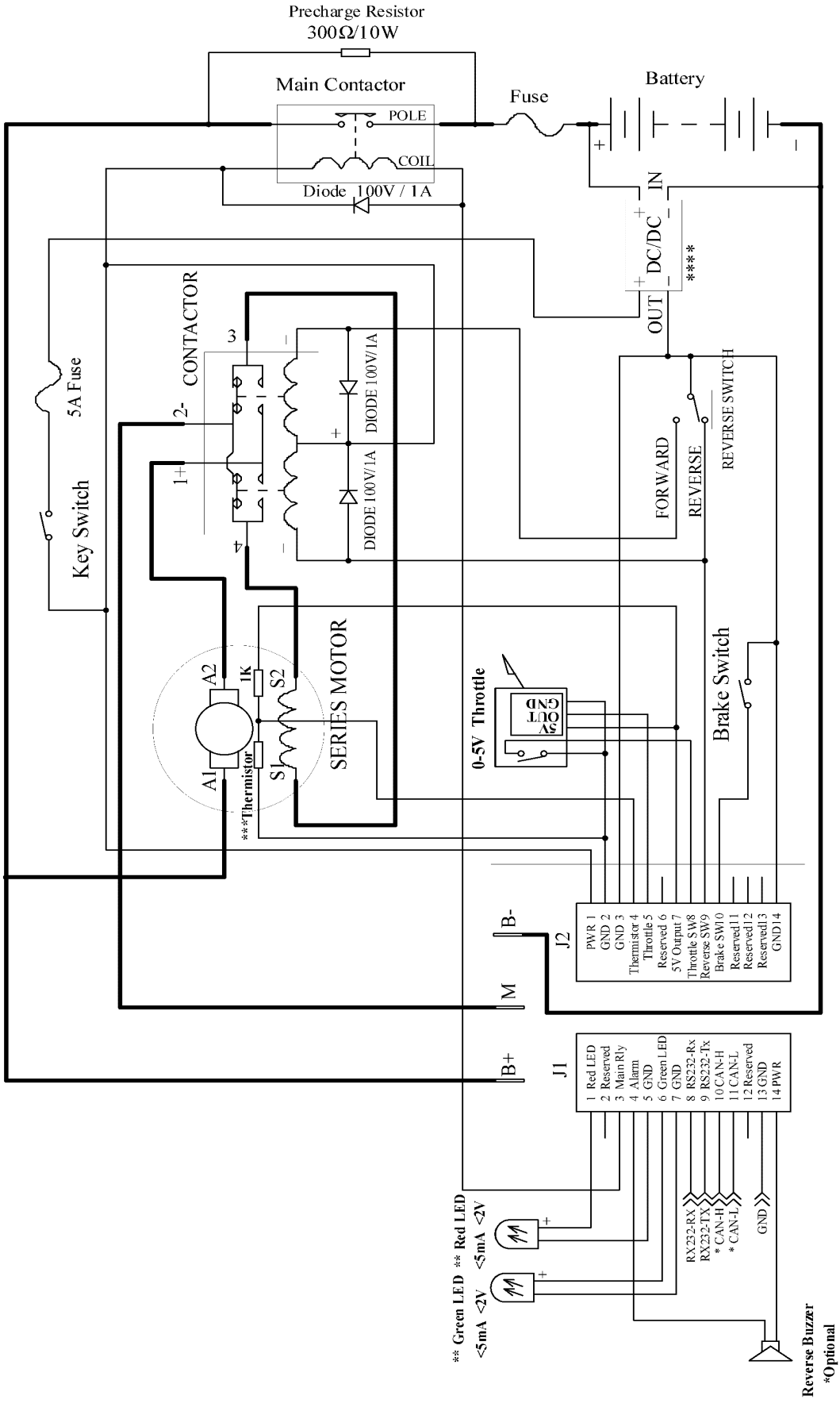


Figure 4: KDHA Series motor controller standard wiring

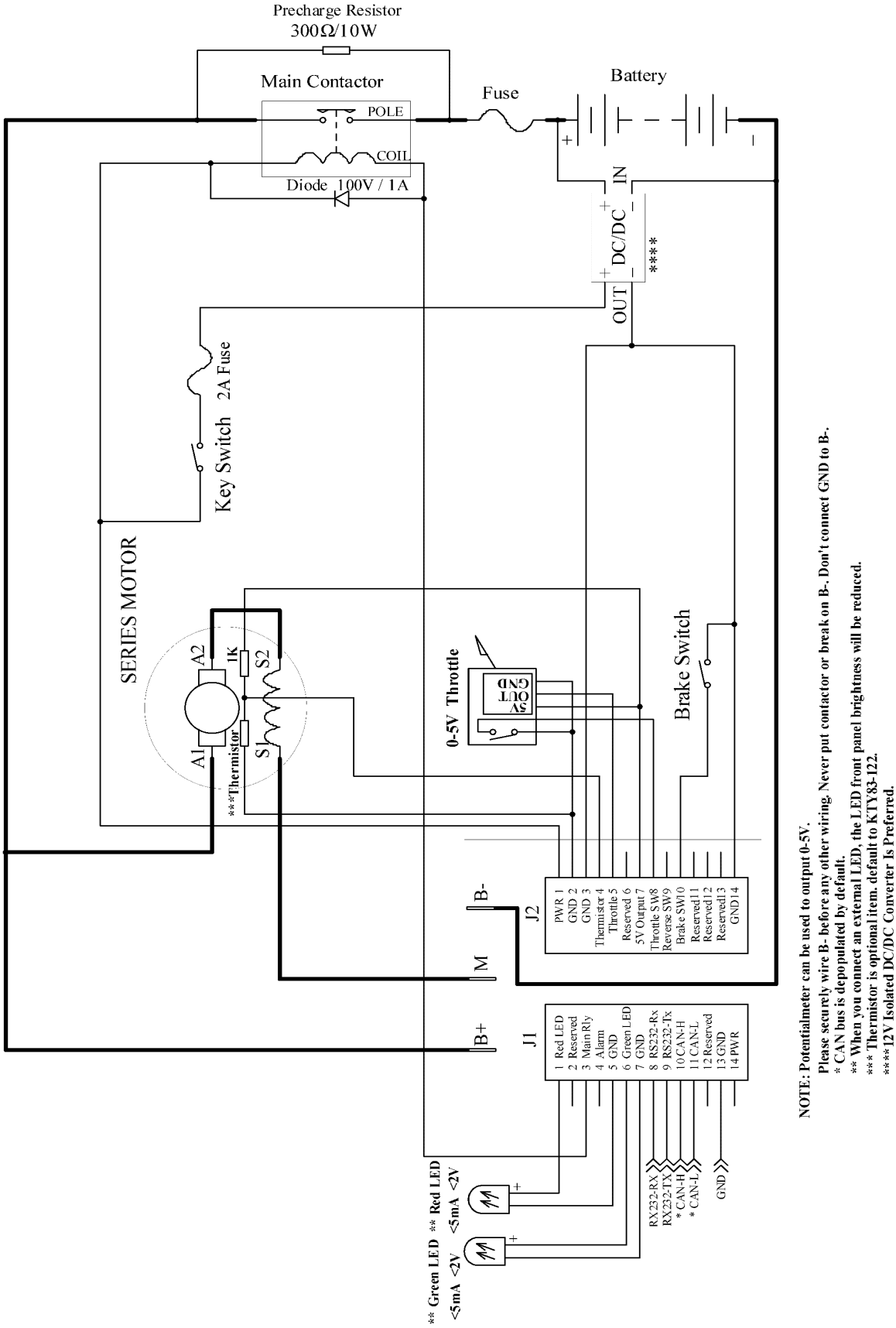


Figure 5:KDHA Series motor controller standard wiring without Reversing Contactor

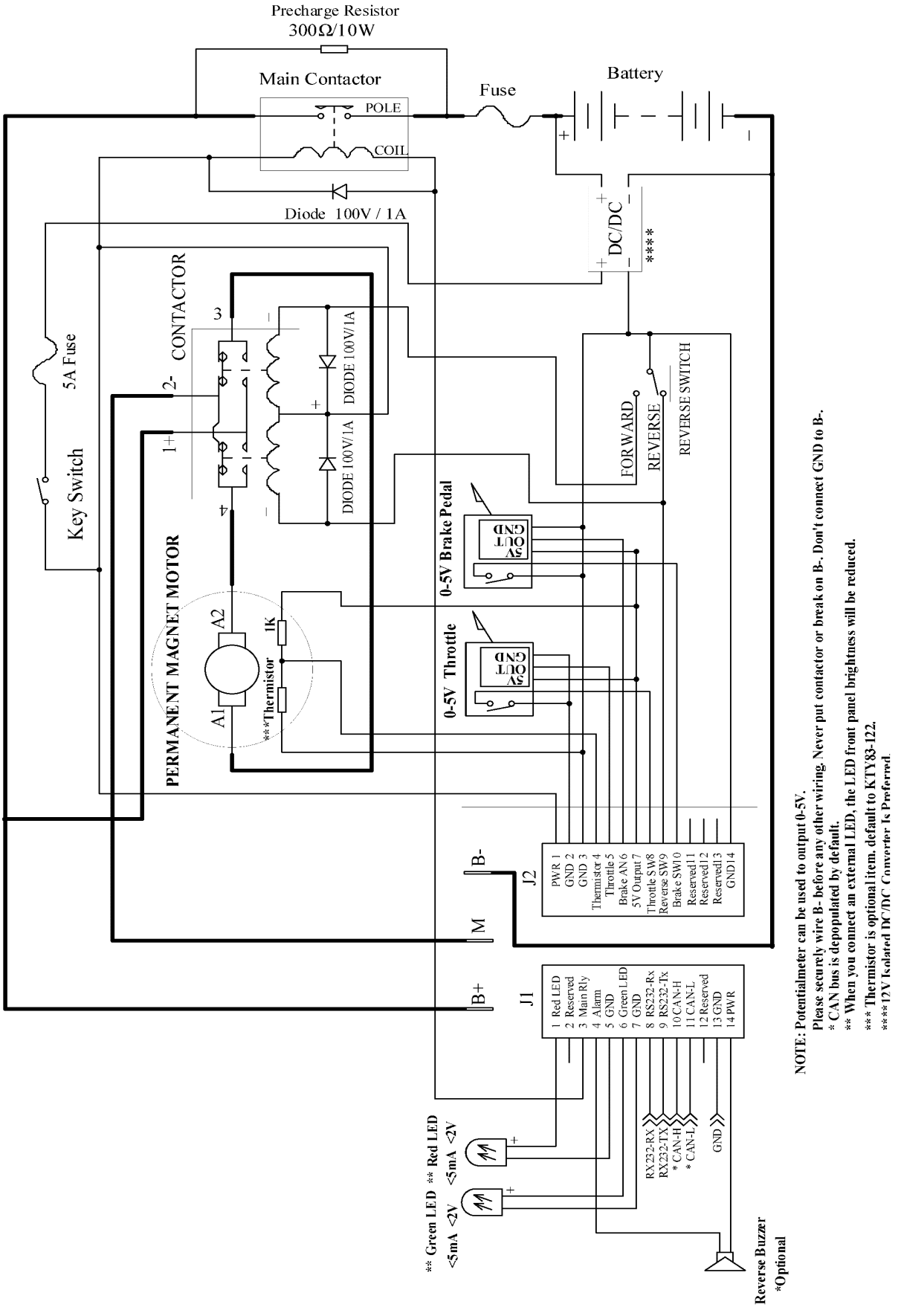


Figure 6: KDHA PM motor controller standard wiring

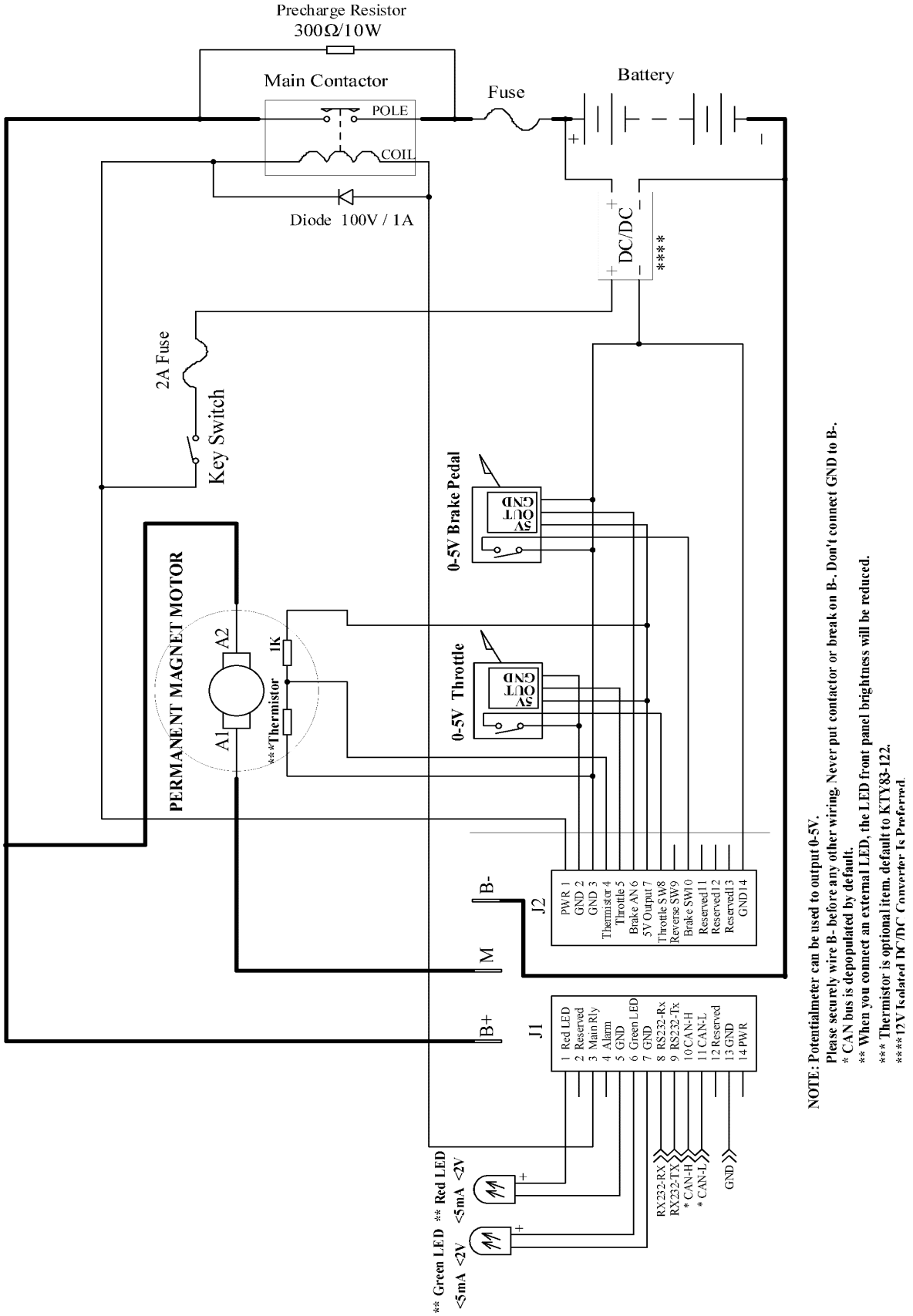


Figure 7:KDHA PM motor controller standard wiring without Reversing Contactor

3.2.3 Communication Port

A RS232 port of controller is provided to communicate with host computer for calibration and configuration.

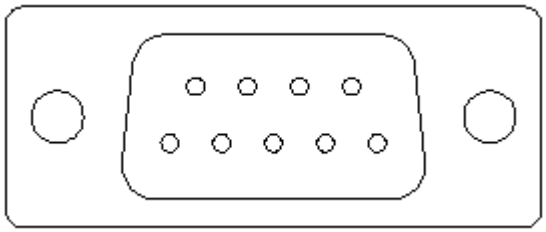


Figure 8: standard RS232 interface

3.3 Installation Checklist

Before operating the vehicle, complete the following checkout procedure. Use LED code as a reference. The LED codes are listed in Table 1.

Caution:
- Put the vehicle up on blocks to get the drive wheels off the ground before beginning these tests.
- Do not allow anyone to stand directly in front of or behind the vehicle during the checkout.
- Make sure the PWR switch and the brake is off
- Use well-insulated tools.

- Make sure the wire is connected correctly
- Turn the PWR switch on. The LED should blink, then keeps on when the controller operates normally. If this does not happen, check continuity of the PWR and controller ground.
- The fault code will be detected automatically at restart.
- With the brake switch open, select a direction and operate the throttle. The motor should spin in the selected direction. Please verify wiring and voltage if it doesn't. Also check fuse. The motor should run faster with increasing throttle. If not, refer to Table 1 LED code, and correct the fault according to the code.
- Take the vehicle off the blocks and drive it in a clear area. It should have smooth acceleration and good top speed.

Chapter 4 Maintenance

There are no user-serviceable parts inside the controllers. Do not attempt to open the controller. Or you will damage it. However, clearing the controller exterior periodically should be necessary.

The controller is inherently a high power device. When working with any battery powered vehicle, proper safety precautions should be taken. These include, but are not limited to: proper training, wearing eye protection, avoiding loose clothing and jewelry, and using insulated wrenches.

4.1 Cleaning

Although the controller requires virtually no maintenance after properly installation, the following minor maintenance is recommended in certain applications.

- Remove power by disconnecting the battery.
- Discharge the capacitors in the controller by connecting a load (such as a contactor coil or a horn) across the controller's B+ and B- terminals.
- Remove any dirt or corrosion from the bus bar area. The controller should be wiped with a moist rag. Be sure it is dry before reconnecting the battery.
- Make sure the connections to the bus bars are tight. Use two wrenches for this task in order to avoid stressing the bus bars; the wrenches should be well insulated.

4.2 Configuration

You can configure the controller with a host computer through RS232.

- Use a standard RS232 cable connecting the 9pin connector on face penal to a host computer. The cable should be straight.
- Provide 8V to 30V supply to PWR (either J2 pin1 or J1 pin14). Wire power supply ground to any GND pin.
- Do not connect B+, throttle and so on. The controller may display fault code, but it doesn't affect programming or configuration.

Table 1: LED CODES

LED Code		Explanation	Solution
Green Off	▬▬▬	No power or not operating	1. Check if all wires are correct. 2. Check fuse and power supply.
Green On	▭	Normal operation	That's great! You got solution!
1,2	¤ ¤¤	Over voltage error	1. Battery voltage is higher than max operating voltage of the controller. Please check the battery voltage and configuration. 2. Over voltage at regeneration. Controller will cut back or stop regeneration.
1,3	¤ ¤¤¤	Low voltage error	1. The controller will attempt to clear the fault code automatically after 5 second if battery return to normal. 2. Check the battery voltage. 3. Charge battery if necessary.
1,4	¤ ¤¤¤¤	Over temperature warning	1. The controller temperature is over 90ºC. The controller will cut back current in the case. Stop or reduce output to ensure the temperature fall. 2. Improve heat sink or airflow
2,1	¤¤ ¤	Throttle sensor fault	1. Check if the connecting is correct. 2. Check if the voltage is in 0-5V.
2,2	¤¤ ¤¤	Internal voltage fault	1. Check if the B+ and PWR voltage are correct, refer to B- or RTN. Could be PWR voltage low. 2. Please check load on 5V supply. Could be high load on 5V. Incorrect pot wiring can load it heavily。 1. The controller is damaged. Please contact Kelly for warrantee.
2,3	¤¤ ¤¤¤	Over temperature	1. The controller temperature is over 100ºC. Controller stops driving in order to protect itself. 2. Stop driving and wait for temperature fall. The controller will restart if temperature drops below 80ºC.
2,4	¤¤ ¤¤¤¤	Throttle error at power up	1. The throttle signal is higher than configured dead zone at power-on 2. The fault will disappear if restart or release throttle.
3,1	¤¤¤ ¤	Frequent reset	1. The controller will stop driving after detect too many resets. 2. Mostly because of B- or return wiring. Use

			heavier and clean return wires. For dual controllers, bond B- of both controllers together with heavy cable or copper strip. 3. Could be over current protection. May set max current lower. 4. Restart will clear the error. 5. Please contact Kelly if it happens repeatedly
3,2	¤¤¤ ¤¤	Internal reset	Reset caused by over current, high battery voltage or low supply voltage. It is normal if occurs occasionally.
3,4	¤¤¤ ¤¤¤¤	Throttle isn't zero when try to change direction	The controller won't change drive direction if throttle isn't zero. Also it won't change direction at high speed. The controller will wait throttle and speed close to zero before change direction.
4,1	¤¤¤¤ ¤	Over voltage at startup or regeneration	The controller won't drive motor if detect overvoltage at power up. It will cut back regen current or stop regen if detect overvoltage during regen. You may set overvoltage threshold with GUI. The max threshold is about 1.25 times of controller rated voltage. I.e. you may set threshold lower than 60V for 48V controller.
The LED flashes once at power on, then keeps on for normal operation. "1, 2" means it flashed once, then flashes twice after 1 second. The time between two flashes is 0.5 second. The pause time between one error code and another error code is 2 second.			

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